# Agenda

## AMEBA Proposers Day

**Friday, Jan. 6th, 2017**

<table>
<thead>
<tr>
<th>Start</th>
<th>End</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:30 AM</td>
<td>10:00 AM</td>
<td>Registration</td>
</tr>
<tr>
<td>10:00 AM</td>
<td>10:30 AM</td>
<td>Welcome and AMEBA Overview</td>
</tr>
<tr>
<td>10:30 AM</td>
<td>10:45 AM</td>
<td>AMEBA Q&amp;A</td>
</tr>
<tr>
<td>10:45 AM</td>
<td>11:00 AM</td>
<td>Contracting Overview</td>
</tr>
<tr>
<td>11:00 AM</td>
<td>11:15 AM</td>
<td>Final Q&amp;A</td>
</tr>
<tr>
<td>11:15 AM</td>
<td>12:30 PM</td>
<td>Lunch (Offsite)</td>
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<tr>
<td>12:30 PM</td>
<td>2:45 PM</td>
<td>Poster Session/Networking</td>
</tr>
<tr>
<td>1:00 PM</td>
<td>2:45 PM</td>
<td>1-on-1 Meetings</td>
</tr>
</tbody>
</table>
Possible Approaches Include Mechanical Motion of Polarized / Magnetized Materials

**Dipole Moment**

\[ \text{Dipole Moment} = \text{Polarization} \times \text{Volume} \]

\[ \text{Dipole Moment} = \text{Magnetization} \times \text{Volume} \]

Rotating Electric Dipole (Electret)

Rotating Magnetic Dipole

AMEBA Objective

Prototype ULF & VLF transmit antennas that generate electromagnetic (EM) fields by mechanically moving trapped charges (electrets) and magnets.

ULF “Ultra Low Frequency”, nominally 0.3 kHz to 3 kHz

VLF “Very Low Frequency”, nominally 3 kHz to 30 kHz
Equivalent Fields

Best magnets
$M_0 = 1.1 \times 10^6 \text{ A/m}$

Best electrets today
3,400 nC/cm²

Permanent magnets & electrets store strong magnetic/electric fields in a material. Producing equivalent fields in a conductor requires significant power.
Importance of Ultra/Very Low Frequency (U/VLF)

- Low bandwidth, but reliable, penetrating and hard to jam!
- RF-denied environments: underwater and underground
- Long-range communications
- GPS denied environment: localization and timing
- Sensitive receivers exist, but efficient transmitters are a challenge!

AMEBA can produce useful field levels for mobile applications not possible today.
The Navy’s VLF Antenna at Cutler, Maine

- Occupies 2,000 acres on a peninsula
- Redundant for reliability and maintenance - two antennas
- 26 towers - 850 to 1000 ft. high
- Power plant 18 MW
- Radiation resistance = 0.2 Ω
- Radiation efficiency up to 75%
- Bandwidth up to 140Hz

Current VLF transmitters have length scales of many kilometers.

Data from:
Hansen, P., J. Chavez, and R. Olsen,
AMEBA at a Glance

• Transmitter systems including antenna and antenna drive
• Targeted RF carrier frequencies < 30 kHz
• Program goals:
  • Low-size, weight, and power (SWaP) – man-portable system
  • Deliver sufficient magnetic field strength for low data rate communications at relevant distances
  • Efficiently modulate the RF carrier at useful data rates

• Total funding anticipated $23M
• Multiple awards under two Technical Areas, approximately:
  • $9.5M for Technical Area 1 (TA1), three phases, 45 months
  • $13.5M for Technical Area 2 (TA2), three phases, 45 months
• Basic research (6.1 funding)
• The program targets innovation in mechanically driven transmitters for their significant promise in achieving the program goals.

• Analogous approaches will be considered as long as they strictly adhere to the metrics specified in the program BAA.

• Specifically excluded under the program are:
  • Pulsed systems that produce short bursts of magnetic field intensity at the BAA specified distances rather than a steady-state oscillating magnetic field
  • Cryogenically cooled systems
  • Receivers with noise floors similar to the background clutter level have been previously developed

A baseline receiver with 1 fT/√Hz noise and clutter floor can be assumed in any estimates or simulations for the purpose of this proposal.
**Technical Area 1: Penetrating RF (<3 kHz)**

**Propagation Losses in Sea Water**

- Attenuation, dB/m
- RF frequency: 10 Hz, 100 Hz, 1 kHz, 10 kHz, 100 kHz
- TA1: ~100 m link

**Propagation Losses Through Shielding Metal**

- Attenuation, dB
- RF frequency: 10 Hz, 100 Hz, 1 kHz, 10 kHz, 100 kHz
- Typical 2 mm SS container wall

AMEBA TA1 targets ULF frequencies and below for difficult RF environments.
## TA1: Penetrating RF – Program Metrics

<table>
<thead>
<tr>
<th>Phase</th>
<th>Phase 1</th>
<th>Phase 2</th>
<th>Phase 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency Range (kHz)</td>
<td>1</td>
<td>0.75 – 1</td>
<td>0.1 – 1</td>
</tr>
<tr>
<td>Steady State Magnetic Field Produced at 1 km (fT)</td>
<td>1</td>
<td>10</td>
<td>100</td>
</tr>
<tr>
<td>Maximum Steady State Input Power (W)</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Maximum Input Energy to Reach Steady State Operation (J)</td>
<td>200</td>
<td>2,000</td>
<td>5,000</td>
</tr>
<tr>
<td>Modulation Rate (Hz/sec)*</td>
<td>1</td>
<td>10</td>
<td>50</td>
</tr>
<tr>
<td>Modulation Energy (J/Hz)*</td>
<td>0.05</td>
<td>0.05</td>
<td>0.01</td>
</tr>
<tr>
<td>Max. Linear Dimension (cm)</td>
<td>15</td>
<td>30</td>
<td>60</td>
</tr>
<tr>
<td>Max. Volume (cm³)</td>
<td>30</td>
<td>300</td>
<td>3,000</td>
</tr>
<tr>
<td>Maximum Weight (kg)</td>
<td>3</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>Minimum Continuous Operating Time (hr)</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Minimum Operating Lifetime (days)</td>
<td>1</td>
<td>10</td>
<td>100</td>
</tr>
<tr>
<td>Operating Temperature Range (°C)</td>
<td>20-30</td>
<td>20-30</td>
<td>0-70</td>
</tr>
<tr>
<td>Peak Acceleration (g)</td>
<td>–</td>
<td>–</td>
<td>2</td>
</tr>
</tbody>
</table>

* If the proposed modulation is not based on frequency modulation (FM), define an equivalent metric and discuss the achievable data rates.
• In Phases 1 and 2, testing is allowed at closer distances and the BAA metric is verified through extrapolation.

• The extrapolation model depends on the source dipole (electric vs. magnetic), but it is a straight-forward solution of Maxwell’s Equations in free space.

• Please specify the testing conditions and the EM model used.
Technical Area 2: Propagating RF (3 kHz to 30 kHz)

Propagation Losses in the Atmosphere

AMEBA TA2 targets VLF frequencies for long-range communications.
**TA2: Propagating RF – Program Metrics**

<table>
<thead>
<tr>
<th>Phase</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Frequency (kHz)</td>
<td>5</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>Maximum Frequency (kHz)</td>
<td>30</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Steady State Magnetic Field Produced (fT)</td>
<td>1 (@ 1 km)</td>
<td>1 (@ 10 km)</td>
<td>100 (@ 10 km)</td>
</tr>
<tr>
<td>Maximum Steady State Input Power (W)</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Maximum Input Energy to Reach Steady State Operation (J)</td>
<td>500</td>
<td>5,000</td>
<td>20,000</td>
</tr>
<tr>
<td>Modulation Rate (Hz/sec)*</td>
<td>10</td>
<td>100</td>
<td>500</td>
</tr>
<tr>
<td>Modulation Energy (J/Hz)*</td>
<td>0.05</td>
<td>0.03</td>
<td>0.02</td>
</tr>
<tr>
<td>Max. Linear Dimension (cm)</td>
<td>15</td>
<td>40</td>
<td>60</td>
</tr>
<tr>
<td>Max. Volume (cm³)</td>
<td>30</td>
<td>300</td>
<td>3,000</td>
</tr>
<tr>
<td>Maximum Weight (kg)</td>
<td>3</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>Minimum Continuous Operating Time (hr)</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
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<td>1</td>
<td>10</td>
<td>100</td>
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<tr>
<td>Peak Acceleration (g)</td>
<td>–</td>
<td>–</td>
<td>2</td>
</tr>
</tbody>
</table>

* If the proposed modulation is not based on frequency modulation (FM), define an equivalent metric and discuss the achievable data rates.
• Testing is allowed at closer distances and the BAA metric is verified through extrapolation. Testing at the actual range is encouraged, if possible.

• The extrapolation model depends on the source dipole (electric vs. magnetic), but it is a straight-forward solution of Maxwell’s Equations in free space.

• Please specify the testing conditions and the EM model used.
• All required components to achieve the transmitter operation are subject to the SWaP requirements by Technical Area and by Phase as defined in the BAA.
• The power and data interfaces to the transmitter should be defined.
Elements of a Successful Technical Proposal

a) Describe the physics-based mechanism that generates the electric/magnetic field at the transmitting element.
   • How does it benchmark against traditional approaches?
   • Specify the amount of energy required to reach steady state at the designed RF frequency.

b) Describe the innovations required to realize the above approach.
   • Materials, methods, reproducibility, packaging, handling, storage, etc.
   • Define measurable milestones by program phase.

c) Describe your scaling strategy to meet the program final goals and beyond.
   • Demonstrate quantitatively through modeling how the approach will meet and exceed the program final goals through scaling.

d) Describe your modulation approach and its implementation.
   • Specify the modulation format and the achievable data rate (in bits-per-second) transmitted.
   • Quantify the energy required to transmit a bit of information.

e) Describe how your approach couples energy to the radiation field (TA2 only).
   • How does your approach overcome the limitations of traditional electrically small antennas?
Collaborative Efforts/Teaming

• The program emphasizes multidisciplinary approaches. A successful proposal must demonstrate sufficient expertise in all requisite technical specialties.

• Complete and self-sufficient teams are required to support the full scope of the effort. Partial solutions will not be accepted.

• The poster session and the time in the afternoon are intended to facilitate forming collaborative teams.
## Important Dates and Program Execution Timeline

**Source Selection Timeline:**

- **BAA Posting Date:** December 15, 2016
- **Proposers Day:** January 6, 2017 (today)
- **Abstract Due Date:** January 17, 2017
- **FAQ Submission Deadline:** March 8, 2017
- **Proposal Due Date:** March 22, 2017
- **Estimated period of performance start:** August 2017
Teaming and Collaboration

- To further facilitate teaming in addition to the afternoon poster session, DARPA will collect and disseminate the contact information and capabilities of those looking to team.
- Please check your email next week for the form.
- Participation is voluntary, but please note, the information will be made available via darpa.mil and submission of the form will serve as your consent to having it publicly published.

**AMEBA Proposers Day Teaming Form**

- This form is intended to introduce your unique capabilities and expertise as related to the AMEBA program technical goals. The full content will be published in the BAA Q&A section on the DARPA public website at darpa.mil. By submitting this form, you give your consent to have the included information openly distributed.
- This form MUST be filled in its entirety. Any incomplete forms will be disregarded!
- The deadline for submitting the form is January 15, 2017. Please submit the form to HR00111750007@darpa.mil

**Organization:**

*(Full name of your organization, no abbreviations)*

**Technical POC:**

**Technical POC e-mail:**
AMEBA Q&A
Microsystems Technology Office
Broad Agency Announcement (BAA)
A MEchanically Based Antenna (AMEBA)
HR001117S0007

Proposers Day

BAA Administrative Review

January 6, 2017
Proposers Day Disclaimer

- Plenty of good information is made available to potential proposers to help clarify program goals/objectives and proposal preparation instructions - those things that are stipulated in the BAA.

- However:
  - Only the information/instructions in the BAA counts.
  - Proposals will only be evaluated in accordance with the instructions provided in the BAA.
  - Any response provided by the Government in the FAQ that’s different than what is provided in the BAA will be effected by an amendment to the BAA.
    - Such responses will make note of an impending BAA amendment.

- Only a duly authorized Contracting Officer may obligate the Government.
What is a BAA?

- A Federal Acquisition Regulation (FAR) Part 35 solicitation instrument.

- Used for the acquisition of basic research (6.1 funding), applied research (6.2 funding), and advanced development (6.3 funding): Science and Technology (S&T).

- Allowing for a variety of technical solutions and award instrument types.
  - The BAA defines the problem set, the proposer defines the solution and the scope of work.
  - The BAA allows for multiple award instrument types:
    - In this case, all types are permitted: grants, cooperative agreements, procurement contracts, and Other Transaction agreements.

- The Government may select for negotiation all, some, or none of the proposals received.
- The Government may accept proposals in their entirety or select only portions thereof.
- The Government may elect to establish portions of proposal as options.
BAA Process - Overview

1. BAA is released (15 December 2016).
2. Proposers Day is conducted (6 January 2017).
3. Abstracts are submitted (17 January 2017).
4. Government provides responses to abstracts (within ~ 30 days)
   • Encourage or discourage full proposal submission & specific feedback.
5. Proposals are submitted (on time!)(22 March 2017).
6. Proposals are reviewed for BAA compliance.
   • Noncompliant proposals are not reviewed and cannot be selected.
   • Proposals are evaluated on individual merit and relevance as it relates to the stated research goals/objectives rather than against one another (there is no common statement of work).
   • Selections will be made to proposers whose proposals are determined to be most advantageous to the Government, all factors considered.
8. Government sends out select/non-select letters (~1 May 2017)
   • All proposers who submit a compliant proposal may request an Informal Feedback Session.
9. Contracting Officer initiates negotiations (awards by ~ 8 August 2017).
Eligibility Issues

All interested/qualified sources may respond subject to the parameters outlined in BAA.

Foreign participants/resources may participate.
- AMEBA - No classified proposals anticipated.

FFRDCs and Government entities:
Are not prohibited by the BAA from proposing.
Are, however, subject to applicable direct competition limitations.
Are, however, required to demonstrate eligibility (sponsor letter).

- The burden to prove eligibility for all such team members rests with the proposer.
- All elements of a proposal (tech and cost, prime and subs) must be included in the prime’s submission in order to be deemed compliant.

Real and/or Perceived Conflicts of Interest:
- Identify any conflict/s.
- If any are identified, a mitigation plan must be included.
AMEBA BAA Specifics

- All awards will be for Fundamental Research (6.1 funded):
  - No publication restrictions or pre-approvals will be required

- AMEBA is a 45-month program, broken into three, progressively more difficult phases:
  - Phase 1 (Base): 18 months
  - Phase 2 (Option): 15 months
  - Phase 3 (Option): 12 months

- AMEBA is divided into two technical areas:
  - Technical Area (TA) 1: Penetrating RF (< 3 kHz) (~$9.5M available)
  - Technical Area (TA) 2: Propagating RF (3 kHz – 30 kHz) (~$13.5M available)

- A single proposal may address:
  ✓ Only TA 1 (Penetrating RF); or
  ✓ Only TA 2 (Propagating RF); or
  ✓ Both TAs 1 and 2 (Penetrating and Propagating RF)
Proposals combining TA1 and TA2 MUST be easily separable in case the Government chooses to exercise partial awards.

Such proposals MUST:

✔ Contain a separate and independent Statement of Work for Each Technical Area.

✔ Contain separate stand alone cost estimates for each Technical Area by Phase. (NOTE: This estimate is in addition to the full cost proposal for a combined TA1+TA2 that includes any cost savings to the government realized by funding both technical areas in a single proposal.)
Proposal Preparation
(Volume I - Technical & Management)

Page Limitations: 20 pages for a single TA, or 25 pages for combining TA1 and TA2.

Detailed Proposal Information:
- Executive Summary (1 page)
- Statement of Work (By TA & Phase)
- Deliverables
- Previous Accomplishments (2 pages)
- Teaming Plan (1 page)
- Single Summary Slide (Does not count towards page count)

- Technical Approach
- Schedule & Milestones (2 pages)
- Risk Mitigation Plan (1 page)
- Facilities (1 page)

- Technical Approach is the centerpiece of the proposal.
- The proposal must address a complete solution; partial solutions will not be considered.
- Make sure to include every proposal topic (above) - the point is to ensure the Gov’t fully understands what you are proposing.
- Make sure to review “Funding Opportunity Description” for additional proposal preparation information/instructions of a technical nature.
Provide an accurate and complete cost proposal.
- Full cost build-up/estimate by TA/Phase/Performer Fiscal Year with all necessary supporting documentation.
- Failure to do this will, at a minimum, negatively impact the assessment of your proposal (i.e., cost realism).
- Weak cost proposals are an indicator that the proposed technical approach is not fully understood.

Subcontractor Proposal(s):
- The prime contractors submission MUST include, at a minimum, a non-proprietary, subcontractor proposal for EACH subcontractor.
- All subcontractors MUST be able to submit a fully disclosed version of their proposal directly to the Government immediately upon request.
- If utilizing FFRDC or Government entity, the proposal MUST included the required eligibility information (this is the primes responsibility).

➤NO ROMS! NO MISSING SUBCONTRACT PROPOSALS!!!!
Proposal Preparation
(Misc.)

- Expected award date (for pricing purposes): ~ 8 August 2017
- Be mindful of the proposal due date!
  - Late is Late!
  - Proposals received after the due date/time will not be reviewed.

Tips:
- When submitting to DARPA BAA Website you must click ‘Finalize Full Proposal’ button at the bottom of the page. It has not been submitted otherwise.
- When submitting to Grants.gov be mindful that there are multiple steps in the process and this process could take days (if not already registered – weeks).
- Be a responsible proposer – don’t wait until the last minute to submit!!!

- BAA includes info provided at www.darpa.mil/work-with-us/additional-baa - please review it.
- Following the proposal preparation instructions assists the evaluation team to clearly understand what is being proposed and supports a timely negotiation.
Data Rights

- Government desires Unlimited Rights to data and/or software deliverables.

- If asserting less than Unlimited Rights (e.g., Restrictions):
  - Provide and justify basis of assertions using the prescribed format (table).
  - Explain how each item will be used to support the proposed research project.
  - Explain how the Government will be able to reach its program goals (including transition).

  ➢ The above Data Rights Cert includes prime and sub info, as applicable.
  ➢ Recommended that this information be provided even if you are proposing other than a contract.
  ➢ Final/Negotiated Data Rights Cert is made a part of the award instrument (for contracts and OT’s).
Communications

- **Prior to Receipt of Proposals (Solicitation Phase):** No restrictions, however Gov’t (PM/PCO) shall not dictate solutions or transfer technology.
  - Typically handled through the FAQ.

- **After Receipt of Proposals/Prior to Selections (Scientific Review Phase):** Limited to Contracting Officer or BAA Coordinator (with approval) to address clarifications requested by the review team.
  - Proposal cannot be changed in response to clarification requests.

- **After Selection/Prior to Award (Negotiation Phase):** Negotiations are conducted by the Contracting Officer.
  - PM and/or COR typically tasked with finalizing the SOW (with PI).
  - PM and/or COR typically involved in any technical discussions (i.e., partial selection discussions).

- **Informal Feedback Sessions (Post Award):** May be requested/provided once the selection(s) are made.
  - If made on a timely basis (~2 wks after letter), all requests will be accepted.
Contracting Q&A
• Networking and Poster Session will begin at 12:30PM upstairs in Hamilton 2001 A & B. We strongly encourage everyone to attend.

• For those who have been selected to have a 1-on-1 meeting, please check-in with Logan outside of Hamilton 2001 C at least 10 minutes prior to your scheduled meeting time.

• Slides from today’s Proposers Day will be made available on the opportunities page of the DARPA website.

• ALL questions regarding AMEBA should be directed to HR001117S0007@darpa.mil. Emails sent directly to myself or any SETA will not be responded to.